# Refine Search

**Search Results -**

| Term | Documents |
|---|---|
| ACKNOWLEDGMENT$ | 0 |
| ACKNOWLEDGMENT | 11423 |
| ACKNOWLEDGMENTEXPECTED | 1 |
| ACKNOWLEDGMENTMENT | 1 |
| ACKNOWLEDGMENTS | 2255 |
| ACKNOWLEDGMENTSIGNAL | 2 |
| ACKNOWLEDGMENTS-ONE | 3 |
| ACKNOWLEDGMENTS-THE | 1 |
| ACKNOWLEDGMENTS+2 | 1 |
| ACKNOWLEDGMENTS/NEGATIVE | 1 |
| ACKNOWLEDGMENTS/RESPONSES | 2 |
| (L10 AND ACKNOWLEDGMENT$).USPT. | 0 |

There are more results than shown above. Click here to view the entire set.

**Database:** US Pre-Grant Publication Full-Text Database; US Patents Full-Text Database; US OCR Full-Text Database; EPO Abstracts Database; JPO Abstracts Database; Derwent World Patents Index; IBM Technical Disclosure Bulletins

**Search:** L11

Refine Search | Recall Text | Clear | Interrupt

## Search History

**DATE: Tuesday, February 08, 2005** Printable Copy Create Case

| Set Name side by side | Query | Hit Count | Set Name result set |
|---|---|---|---|
| | *DB=USPT; PLUR=YES; OP=ADJ* | | |

h e b b cg b e e ch

| | | | |
|---|---|---|---|
| L11 | L10 and acknowledgment$ | 0 | L11 |
| L10 | 6292834.pn. | 1 | L10 |
| L9 | L1 and (select$ with match$ with (capacity or bandwidth)) | 23 | L9 |
| L8 | L1 and (select$ with (capacity or bandwidth)) | 1489 | L8 |
| L7 | L1 and (select$ with (sent or send$) with match$ with (capacity or bandwidth)) | 0 | L7 |
| L6 | L1 and (match$ with (capacity or bandwidth)) | 328 | L6 |
| L5 | L1 and (select with number with acknowledgment with received with sent) | 0 | L5 |
| L4 | L2 and (match$ with bandwidth) | 0 | L4 |
| L3 | L2 and (match$ with capacity) | 0 | L3 |
| L2 | L1 and (number with acknowledgment with received with sent) | 45 | L2 |
| L1 | 709/$.ccls. or 714/$.ccls. | 40281 | L1 |

END OF SEARCH HISTORY

h e b b cg b e e ch

# Refine Search

**Search Results -**

| Term | Documents |
|---|---|
| BANDWIDTH | 108037 |
| BANDWIDTHS | 15024 |
| MATCH$ | 0 |
| MATCH | 229485 |
| MATCHA | 60 |
| MATCHABE | 1 |
| MATCHABELLI | 6 |
| MATCHABILITY | 81 |
| MATCHABILITY-ORIENTED | 1 |
| MATCHABLE | 412 |
| MATCHABLE/RETRIEVABLE | 1 |
| (L2 AND (MATCH$ WITH BANDWIDTH)).USPT. | 0 |

There are more results than shown above. Click here to view the entire set.

**Database:**
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

**Search:** L4

Refine Search  Recall Text  Clear  Interrupt

## Search History

**DATE: Tuesday, February 08, 2005** Printable Copy Create Case

| Set Name side by side | Query | Hit Count | Set Name result set |
|---|---|---|---|
| | *DB=USPT; PLUR=YES; OP=ADJ* | | |
| L4 | L2 and (match$ with bandwidth) | 0 | L4 |

h e b b cg b e e ch

| | | | |
|---|---|---|---|
| L3 | L2 and (match$ with capacity) | 0 | L3 |
| L2 | L1 and (number with acknowledgment with received with sent) | 45 | L2 |
| L1 | 709/$.ccls. or 714/$.ccls. | 40281 | L1 |

END OF SEARCH HISTORY

h e b b cg b e e ch

US006839770B1

(12) **United States Patent**
**Dillon**

(10) **Patent No.: US 6,839,770 B1**
(45) **Date of Patent: Jan. 4, 2005**

(54) **APPARATUS AND METHOD FOR ACCESS TO NETWORK VIA SATELLITE**

(75) Inventor: **Douglas M. Dillon**, Gaithersburg, MD (US)

(73) Assignee: **Hughes Electronics Corporation**, El Segundo, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/559,118**

(22) Filed: **Apr. 26, 2000**

**Related U.S. Application Data**

(62) Division of application No. 09/204,436, filed on Dec. 3, 1998, which is a division of application No. 08/901,152, filed on Jul. 28, 1997, now Pat. No. 5,995,725, which is a continuation of application No. 08/257,670, filed on Jun. 8, 1994, now abandoned.

(51) **Int. Cl.**[7] ..... **G06F 15/16**
(52) **U.S. Cl.** ..... **709/245**; 709/219; 709/230; 709/227
(58) **Field of Search** ..... 709/217–219, 709/245, 227–229, 230–236; 713/200–202; 725/63, 68; 704/219, 230

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 4,018,993 | A | 4/1977 | Edström | 370/316 |
| 4,135,156 | A | 1/1979 | Sanders, Jr. et al. | 325/4 |
| 4,358,672 | A | 11/1982 | Hyatt et al. | 235/380 |
| 4,538,073 | A | 8/1985 | Freige et al. | 307/33 |
| 4,599,647 | A | 7/1986 | George et al. | 358/122 |
| 4,636,879 | A | 1/1987 | Narita et al. | 360/72.2 |
| 4,663,743 | A | 5/1987 | Rampuria et al. | 367/68 |
| 4,680,688 | A | 7/1987 | Inou et al. | 363/21 |
| 4,686,698 | A | 8/1987 | Tompkins et al. | 379/53 |
| 4,720,873 | A | 1/1988 | Goodman et al. | 455/2 |
| 4,724,520 | A | 2/1988 | Athanas et al. | 364/200 |
| 4,736,422 | A | 4/1988 | Mason | 380/20 |
| 4,768,228 | A | 8/1988 | Clupper et al. | 380/20 |
| 4,775,974 | A | 10/1988 | Kobayashi | 370/104 |
| 4,777,657 | A | 10/1988 | Gillaspie | 455/186 |

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

| | | |
|---|---|---|
| EP | 0 483 547 | 5/1992 |
| JP | 55-120249 | 9/1980 |
| JP | 56-2765 | 1/1981 |
| JP | 59-135948 | 8/1984 |
| JP | 50-167533 | 8/1985 |
| JP | 61-70823 | 4/1986 |
| JP | 61-210745 | 9/1986 |
| JP | 62-189823 | 8/1987 |
| JP | 62-221228 | 9/1987 |
| JP | 63-107254 | 5/1988 |

(List continued on next page.)

OTHER PUBLICATIONS

M. H. Hadjitheodosiou, et al., "End–to–end performance analysis for broadband island interconnection via satellite—RACE II/R2074 (Catalyst) project", Nov. 1993, pp. 170–174.

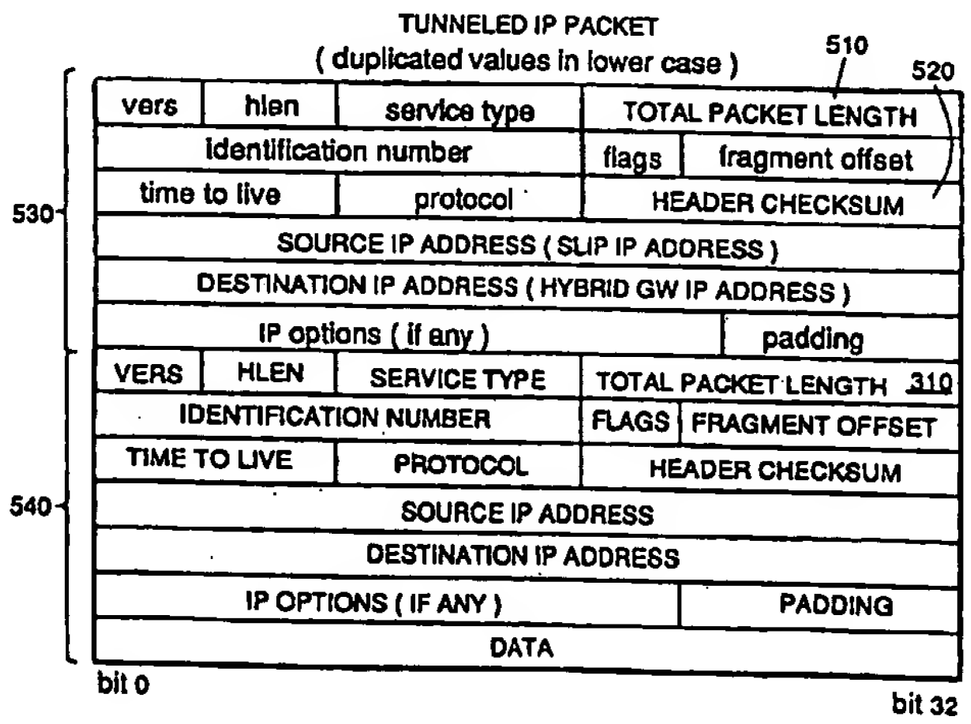
(List continued on next page.)

*Primary Examiner*—David Wiley
*Assistant Examiner*—Joseph Avellino
(74) *Attorney, Agent, or Firm*—John T. Whelan

(57) **ABSTRACT**

A system in which a personal computer sends messages into a TCP/IP network using a conventional dial-up link and downloads data from the TCP/IP network using a high-speed one-way satellite link. A preferred embodiment uses a conventional SLIP provider to connect to the TCP/IP network and uses a commercial software TCP/IP package that has a standard driver interface. A spoofing protocol compensates for the long propagation delays inherent to satellite communication.

**53 Claims, 10 Drawing Sheets**



# Refine Search

**Search Results -**

| Term | Documents |
|---|---|
| SELECT | 346396 |
| SELECTS | 166865 |
| NUMBER | 1892359 |
| NUMBERS | 447006 |
| ACKNOWLEDGMENT | 11423 |
| ACKNOWLEDGMENTS | 2255 |
| RECEIVED | 841922 |
| RECEIVEDS | 3 |
| SENT | 267173 |
| SENTS | 82 |
| ((ACKNOWLEDGMENT WITH SENT WITH SELECT WITH RECEIVED WITH NUMBER) AND 1).USPT. | 0 |
| (L1 AND (SELECT WITH NUMBER WITH ACKNOWLEDGMENT WITH RECEIVED WITH SENT) ).USPT. | 0 |

**Database:**
- US Pre-Grant Publication Full-Text Database
- US Patents Full-Text Database
- US OCR Full-Text Database
- EPO Abstracts Database
- JPO Abstracts Database
- Derwent World Patents Index
- IBM Technical Disclosure Bulletins

**Search:** L5

Refine Search | Recall Text | Clear | Interrupt

## Search History

**DATE: Tuesday, February 08, 2005** Printable Copy Create Case

| Set Name side by side | Query | Hit Count | Set Name result set |
|---|---|---|---|

h e b b cg b e e ch

*DB=USPT; PLUR=YES; OP=ADJ*

| | | | |
|---|---|---|---|
| L5 | L1 and (select with number with acknowledgment with received with sent) | 0 | L5 |
| L4 | L2 and (match$ with bandwidth) | 0 | L4 |
| L3 | L2 and (match$ with capacity) | 0 | L3 |
| L2 | L1 and (number with acknowledgment with received with sent) | 45 | L2 |
| L1 | 709/$.ccls. or 714/$.ccls. | 40281 | L1 |

END OF SEARCH HISTORY

h e b b cg b e e ch

# Refine Search

**Search Results -**

| Term | Documents |
|---|---|
| CAPACITY | 472548 |
| CAPACITIES | 39457 |
| CAPACITYS | 2 |
| BANDWIDTH | 108037 |
| BANDWIDTHS | 15024 |
| SELECT$ | 0 |
| SELECT | 346396 |
| SELECTA | 69 |
| SELECTABBLE | 1 |
| SELECTABE | 2 |
| SELECTABEL | 7 |
| (L1 AND (SELECT$ WITH MATCH$ WITH (CAPACITY OR BANDWIDTH))).USPT. | 23 |

There are more results than shown above. Click here to view the entire set.

**Database:**
US Pre-Grant Publication Full-Text Database
US Patents Full-Text Database
US OCR Full-Text Database
EPO Abstracts Database
JPO Abstracts Database
Derwent World Patents Index
IBM Technical Disclosure Bulletins

**Search:** L9

Refine Search

Recall Text  Clear  Interrupt

## Search History

**DATE: Tuesday, February 08, 2005** Printable Copy Create Case

| Set Name side by side | Query | Hit Count | Set Name result set |
|---|---|---|---|

h e b b cg b e e ch

*DB=USPT; PLUR=YES; OP=ADJ*

| | | | |
|---|---|---|---|
| L9 | L1 and (select$ with match$ with (capacity or bandwidth)) | 23 | L9 |
| L8 | L1 and (select$ with (capacity or bandwidth)) | 1489 | L8 |
| L7 | L1 and (select$ with (sent or send$) with match$ with (capacity or bandwidth)) | 0 | L7 |
| L6 | L1 and (match$ with (capacity or bandwidth)) | 328 | L6 |
| L5 | L1 and (select with number with acknowledgment with received with sent) | 0 | L5 |
| L4 | L2 and (match$ with bandwidth) | 0 | L4 |
| L3 | L2 and (match$ with capacity) | 0 | L3 |
| L2 | L1 and (number with acknowledgment with received with sent) | 45 | L2 |
| L1 | 709/$.ccls. or 714/$.ccls. | 40281 | L1 |

END OF SEARCH HISTORY

h e b b cg b e e ch

Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 11 of 23 File: USPT Sep 18, 2001

DOCUMENT-IDENTIFIER: US 6292834 B1
** See image for Certificate of Correction **
TITLE: Dynamic bandwidth selection for efficient transmission of multimedia streams in a computer network

Detailed Description Text (18):
The present invention is directed at the efficient and reliable streaming of data packets from stream server 220 to client computer 240, accomplished by optimally utilizing the bandwidth of the connection provided by computer network 290 while minimizing the loss of packets. In one embodiment, the transmission rate of the data stream is dynamically adjusted in response to changes in the bandwidth made available by computer network 290 for the network connection between server 220 and client computer 240. Accordingly, server 220, in response to feedback from client computer 240, dynamically selects transmission rates in order to better match the varying bandwidth capacity of the network connection. For example, server 220 streams video packets at 1 frames/second (fps), 5 fps, 10 fps, and 15 fps for bandwidths of 4 kbits/second (kbps), 14 kbps, 18 kbps, and 44 kbps.

Current US Original Classification (1):
709/233

Current US Cross Reference Classification (1):
709/216

Current US Cross Reference Classification (2):
709/225

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006292834B1

(12) **United States Patent**
**Ravi et al.**

(10) **Patent No.: US 6,292,834 B1**
(45) **Date of Patent: *Sep. 18, 2001**

(54) **DYNAMIC BANDWIDTH SELECTION FOR EFFICIENT TRANSMISSION OF MULTIMEDIA STREAMS IN A COMPUTER NETWORK**

(75) Inventors: **Hemanth Srinivas Ravi**, Milpitas; **Anders Edgar Klemets**; **Navin Chaddha**, both of Sunnyvale; **David de Val**, Mountain View, all of CA (US)

(73) Assignee: **Microsoft Corporation**, Redmond, WA (US)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).
Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/818,127**

(22) Filed: **Mar. 14, 1997**

(51) **Int. Cl.**[7] ..... **G06F 15/167**; G06F 15/173

(52) **U.S. Cl.** ..... **709/233**; 709/216; 709/225

(58) **Field of Search** ..... 370/232, 233, 370/234, 236; 709/203, 207, 212, 216, 217, 218, 219, 223, 224, 225, 231, 232, 233, 102, 104, 105; 707/10

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 4,862,264 | 8/1989 | Wells et al. | 358/138 |
| 4,931,950 | 6/1990 | Isle et al. | 364/513 |

OTHER PUBLICATIONS

Yuang, M.C. et al. "Dynamic Video Playout Smoothing Method for Multimedia Applications" IEEE ICC'96, 1996.*
Feng, Wu–Chi et al. "A Comparison of Bandwidth Smoothing Techniques for the Transmission of Prerecorded Compressed Video" 16th Joint Conference of IEEE CCS, 1997.*

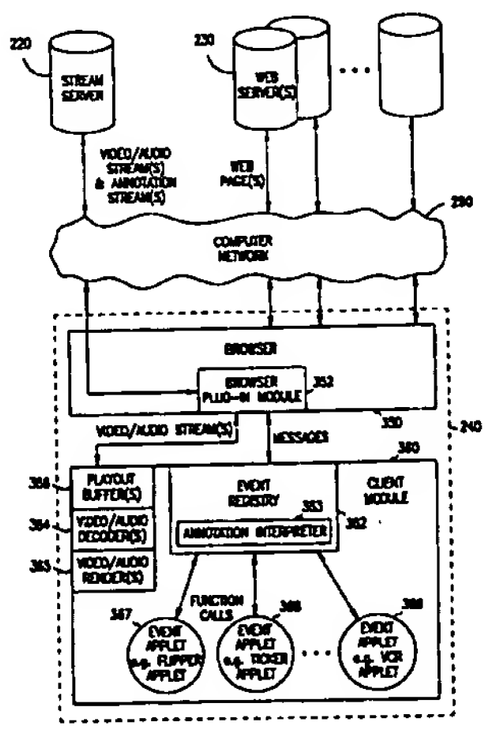
(List continued on next page.)

*Primary Examiner*—Zarni Maung
*Assistant Examiner*—Jason D. Cardone
(74) *Attorney, Agent, or Firm*—Lee & Hayes, PLLC

(57) **ABSTRACT**

An efficient transmission protocol for transmitting multimedia streams from a server to a client computer over a diverse computer network including local area networks (LANs) and wide area networks (WANs) such as the internet. The client computer includes a playout buffer, and the transmission rate is dynamically matched to the available bandwidth capacity of the network connection between the server and the client computer. If a playtime of the playout buffer, which is one measure of the number of data packets currently in the playout buffer, drops below a dynamically computed Decrease_Bandwidth (DEC_BW) threshold, then the transmission rate is decreased by sending a DEC_BW message to the server. Conversely, if the number of packets remaining in the playout buffer rises above a dynamically computed Upper Increase_Bandwidth (INC_BW) threshold and does not drop below a Lower INC_BW threshold for at least an INC_BW wait period, then the transmission rate is incremented. The transmission rate can be selected from among a predetermined set of discrete bandwidth values or from within a continuous range of bandwidth values. In one variation, in addition to responding to changes in network connection capacity, the client computer also determines an average client computational capacity. Accordingly, if the average client computational capacity is less than the network capacity, the lower of the two capacities is the determining one, thereby avoiding a playout buffer overrun.

**42 Claims, 18 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 17 of 23 File: USPT Jul 20, 1999

DOCUMENT-IDENTIFIER: US 5926623 A
TITLE: Method for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity

Detailed Description Text (6):
According to a fourth aspect of the present invention, a method is provided for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity, comprising the step of selectively transferring a record, among data specified to be transferred, that matches a predetermined condition.

Current US Original Classification (1):
709/200

Current US Cross Reference Classification (2):
709/202

Current US Cross Reference Classification (3):
709/219

Current US Cross Reference Classification (4):
709/228

Current US Cross Reference Classification (5):
709/232

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US005926623A

# United States Patent [19]

Tsukakoshi et al.

[11] Patent Number: 5,926,623

[45] Date of Patent: Jul. 20, 1999

[54] **METHOD FOR TRANSMITTING DATA FROM A FIRST PROCESSING UNIT HAVING A RELATIVELY LARGE MEMORY CAPACITY TO A SECOND PROCESSING UNIT HAVING A RELATIVELY SMALL MEMORY CAPACITY**

[75] Inventors: **Nobuyuki Tsukakoshi**, Yokohama; **Takashi Oshiyama**, Fujisawa, both of Japan

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **08/778,317**

[22] Filed: **Jan. 2, 1997**

[30] **Foreign Application Priority Data**

Jan. 29, 1996 [JP] Japan ..... 8-012790

[51] **Int. Cl.**[6] ..... **G06F 3/00**; G06F 15/62

[52] **U.S. Cl.** ..... **395/200.3**; 395/200.32; 395/200.49; 395/200.58; 395/200.62; 707/1; 707/104

[58] **Field of Search** ..... 395/200.3, 200.61, 395/200.62, 200.47, 200.58, 200.32; 364/231.1, 231.2, 231.3, 231.31, 243.1; 707/1, 104

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 4,534,012 | 8/1985 | Yokozawa | 368/327 |
| 5,377,326 | 12/1994 | Murata et al. | 395/200 |
| 5,392,390 | 2/1995 | Crozier | 395/161 |

FOREIGN PATENT DOCUMENTS

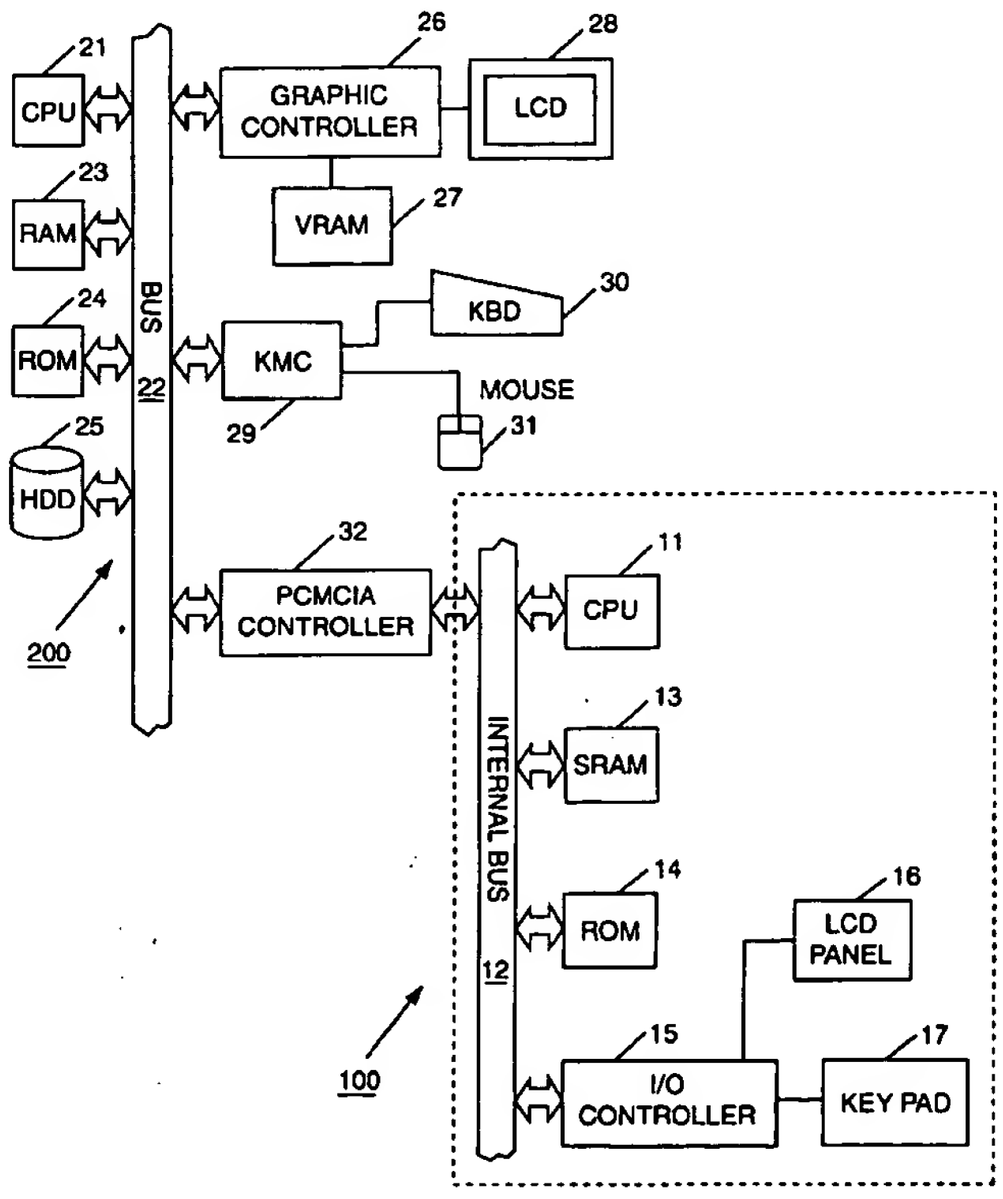
| | | | |
|---|---|---|---|
| 0317481 | 5/1989 | European Pat. Off. | G06F 15/16 |
| 9306553 | 4/1993 | WIPO | G06F 13/28 |
| 9412938 | 6/1994 | WIPO | G06F 15/02 |

*Primary Examiner*—Dung C. Dinh
*Assistant Examiner*—Q.-K. Le
*Attorney, Agent, or Firm*—Anthony N. Magistrale; Daniel E. McConnell

[57] **ABSTRACT**

A data transmission method for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity. The method has steps of (a) retrieving data stored in a first memory device, (b) storing in a temporary file only a record, from the retrieved data, relating to a predetermined time period including a current date; (c) determining whether or not the size of the temporary file is within the capacity of a second, smaller capacity, memory device; and (d) transferring the temporary file to the second processing unit in response to an affirmative result of the step (c), or not transferring the temporary file to the second processing unit in response to a negative result of the step (c).

**2 Claims, 10 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 18 of 23 File: USPT Jun 29, 1999

DOCUMENT-IDENTIFIER: US 5918002 A
TITLE: Selective retransmission for efficient and reliable streaming of multimedia packets in a computer network .

Abstract Text (1):
An efficient and reliable transmission protocol for transmitting multimedia streams from a server to a client computer over a diverse computer network including local area networks (LANs) and wide area networks (WANs) such as the internet. The client computer includes a playout buffer for temporary storage of incoming data packets. When the client computer detects that a data packet has not arrived at said client computer by an expected time of arrival (ETA), a round trip time for the data packet is computed. The round trip time is an estimate of a period beginning from the time a retransmission request is sent to from the client computer to the stream server till the time a copy of the missing data packet is received at the client computer from the stream server in response to the retransmission request. If the round trip time is less than the time remaining before the missing packet is no longer useful to the on-demand application, then a retransmission request packet is sent to the server. Conversely if the round trip time is greater than the time remaining, i.e., the missing packet is likely to arrive after the usefulness of the packet has expired, then sending a retransmission request is likely to result in the late arrival of the missing data packet. Accordingly, the missing packet is discarded. This selective retransmission protocol can also be practiced with dynamic bandwidth selection wherein the transmission rate is dynamically matched to the available bandwidth capacity of the network connection between the server and the client computer.

Brief Summary Text (13):
The selective retransmission of the present invention can also be practiced with a dynamic bandwidth selection wherein the transmission rate is dynamically matched to the available bandwidth capacity of the network connection between the server and the client computer. The transmission rate is selected from among a predetermined set of discrete bandwidth values. However dynamic bandwidth selection is also applicable to a system in which the transmission rate is selected from within a continuous range of bandwidth values.

Detailed Description Text (18):
The present invention is directed at the efficient and reliable streaming of data packets from stream server 220 to client computer 240, accomplished by optimally utilizing the bandwidth of the connection provided by computer network 290 while minimizing the loss of packets. In one embodiment, the transmission rate of the data stream is dynamically adjusted in response to changes in the bandwidth made available by computer network 290 for the network connection between server 220 and client computer 240. Accordingly, server 220, in response to feedback from client computer 240, dynamically selects transmission rates in order to better match the varying bandwidth capacity of the network connection. For example, server 220 streams video packets at 1 frames/second (fps), 5 fps, 10 fps, and 15 fps for bandwidths of 4 kbits/second (kbps), 14 kbps, 18 kbps, and 44 kbps.

Current US Original Classification (1):

h e b b g e e e f e hf e e g

714/18

Current US Cross Reference Classification (2):
714/748

Current US Cross Reference Classification (3):
714/749

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US005918002A

# United States Patent [19]

**Klemets et al.**

[11] **Patent Number: 5,918,002**

[45] **Date of Patent: Jun. 29, 1999**

[54] **SELECTIVE RETRANSMISSION FOR EFFICIENT AND RELIABLE STREAMING OF MULTIMEDIA PACKETS IN A COMPUTER NETWORK**

[75] Inventors: **Anders Edgar Klemets**, Sunnyvale; **Anthony William Cannon**, Mountain View; **Srinivas Prasad Vellanki**; **Hemanth Srinivas Ravi**, both of Milpitas, all of Calif.

[73] Assignee: **Microsoft Corporation**, Redmond, Wash.

[21] Appl. No.: **08/818,644**

[22] Filed: **Mar. 14, 1997**

[51] **Int. Cl.**[6] ..... **H04L 1/08**; H04L 1/10

[52] **U.S. Cl.** ..... **395/182.16**; 371/32; 371/33; 455/7

[58] **Field of Search** ..... 371/32, 33, 35; 395/192.16; 455/7

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 3,956,589 | 5/1976 | Weathers et al. . | |
| 3,979,719 | 9/1976 | Tooley et al. . | |
| 5,050,161 | 9/1991 | Golestani | 370/60 |
| 5,265,103 | 11/1993 | Brightwell | 371/32 |
| 5,313,454 | 5/1994 | Bustini et al. | 370/13 |
| 5,410,536 | 4/1995 | Shah et al. | 371/33 |
| 5,434,848 | 7/1995 | Chimento, Jr. et al. | 370/17 |
| 5,487,167 | 1/1996 | Dinallo et al. | 395/650 |
| 5,490,252 | 2/1996 | Macera et al. | 395/200.1 |
| 5,504,744 | 4/1996 | Adams et al. | 370/60.1 |
| 5,519,701 | 5/1996 | Colmant et al. | 370/60.1 |
| 5,566,175 | 10/1996 | Davis | 370/84 |
| 5,574,724 | 11/1996 | Bales et al. | 370/68.1 |
| 5,577,258 | 11/1996 | Cruz et al. | 395/800 |
| 5,612,949 | 3/1997 | Bennet . | |
| 5,754,754 | 5/1998 | Dudley et al. | 395/182.16 |
| 5,774,479 | 6/1998 | Lee et al. | 371/33 |

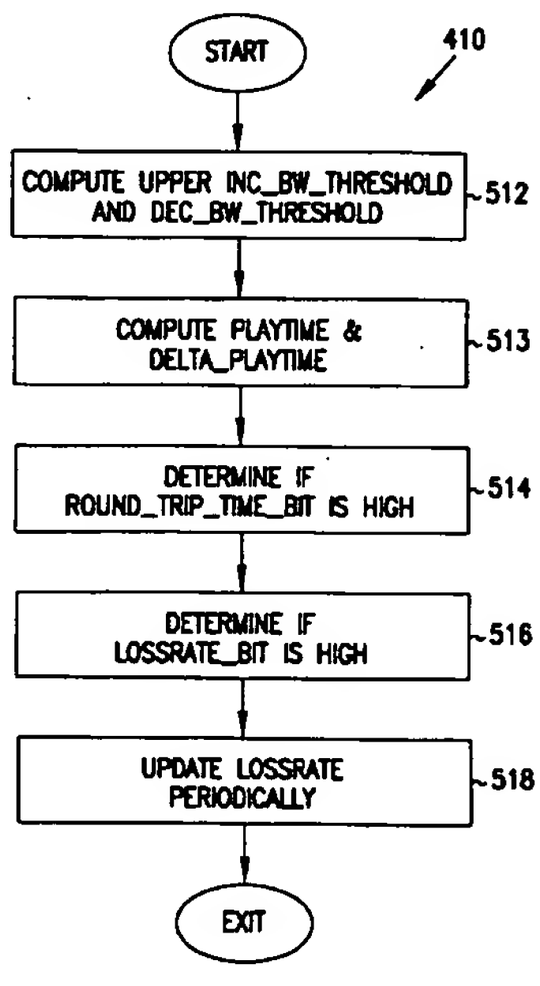
*Primary Examiner*—Ly V. Hua

*Attorney, Agent, or Firm*—Schwegman, Lundberg, Woessner & Kluth, P.A.

[57] **ABSTRACT**

An efficient and reliable transmission protocol for transmitting multimedia streams from a server to a client computer over a diverse computer network including local area networks (LANs) and wide area networks (WANs) such as the internet. The client computer includes a playout buffer for temporary storage of incoming data packets. When the client computer detects that a data packet has not arrived at said client computer by an expected time of arrival (ETA), a round trip time for the data packet is computed. The round trip time is an estimate of a period beginning from the time a retransmission request is sent to from the client computer to the stream server till the time a copy of the missing data packet is received at the client computer from the stream server in response to the retransmission request. If the round trip time is less than the time remaining before the missing packet is no longer useful to the on-demand application, then a retransmission request packet is sent to the server. Conversely if the round trip time is greater than the time remaining, i.e., the missing packet is likely to arrive after the usefulness of the packet has expired, then sending a retransmission request is likely to result in the late arrival of the missing data packet. Accordingly, the missing packet is discarded. This selective retransmission protocol can also be practiced with dynamic bandwidth selection wherein the transmission rate is dynamically matched to the available bandwidth capacity of the network connection between the server and the client computer.

**38 Claims, 18 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 17 of 23 File: USPT Jul 20, 1999

DOCUMENT-IDENTIFIER: US 5926623 A
TITLE: Method for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity

Detailed Description Text (6):
According to a fourth aspect of the present invention, a method is provided for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity, comprising the step of selectively transferring a record, among data specified to be transferred, that matches a predetermined condition.

Current US Original Classification (1):
709/200

Current US Cross Reference Classification (2):
709/202

Current US Cross Reference Classification (3):
709/219

Current US Cross Reference Classification (4):
709/228

Current US Cross Reference Classification (5):
709/232

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US005926623A

# United States Patent [19]

Tsukakoshi et al.

[11] Patent Number: 5,926,623

[45] Date of Patent: Jul. 20, 1999

[54] **METHOD FOR TRANSMITTING DATA FROM A FIRST PROCESSING UNIT HAVING A RELATIVELY LARGE MEMORY CAPACITY TO A SECOND PROCESSING UNIT HAVING A RELATIVELY SMALL MEMORY CAPACITY**

[75] Inventors: **Nobuyuki Tsukakoshi**, Yokohama; **Takashi Oshiyama**, Fujisawa, both of Japan

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[21] Appl. No.: **08/778,317**

[22] Filed: **Jan. 2, 1997**

[30] **Foreign Application Priority Data**

Jan. 29, 1996 [JP] Japan ..... 8-012790

[51] **Int. Cl.**[6] ..... **G06F 3/00**; G06F 15/62

[52] **U.S. Cl.** ..... **395/200.3**; 395/200.32; 395/200.49; 395/200.58; 395/200.62; 707/1; 707/104

[58] **Field of Search** ..... 395/200.3, 200.61, 395/200.62, 200.47, 200.58, 200.32; 364/231.1, 231.2, 231.3, 231.31, 243.1; 707/1, 104

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 4,534,012 | 8/1985 | Yokozawa | 368/327 |
| 5,377,326 | 12/1994 | Murata et al. | 395/200 |
| 5,392,390 | 2/1995 | Crozier | 395/161 |

FOREIGN PATENT DOCUMENTS

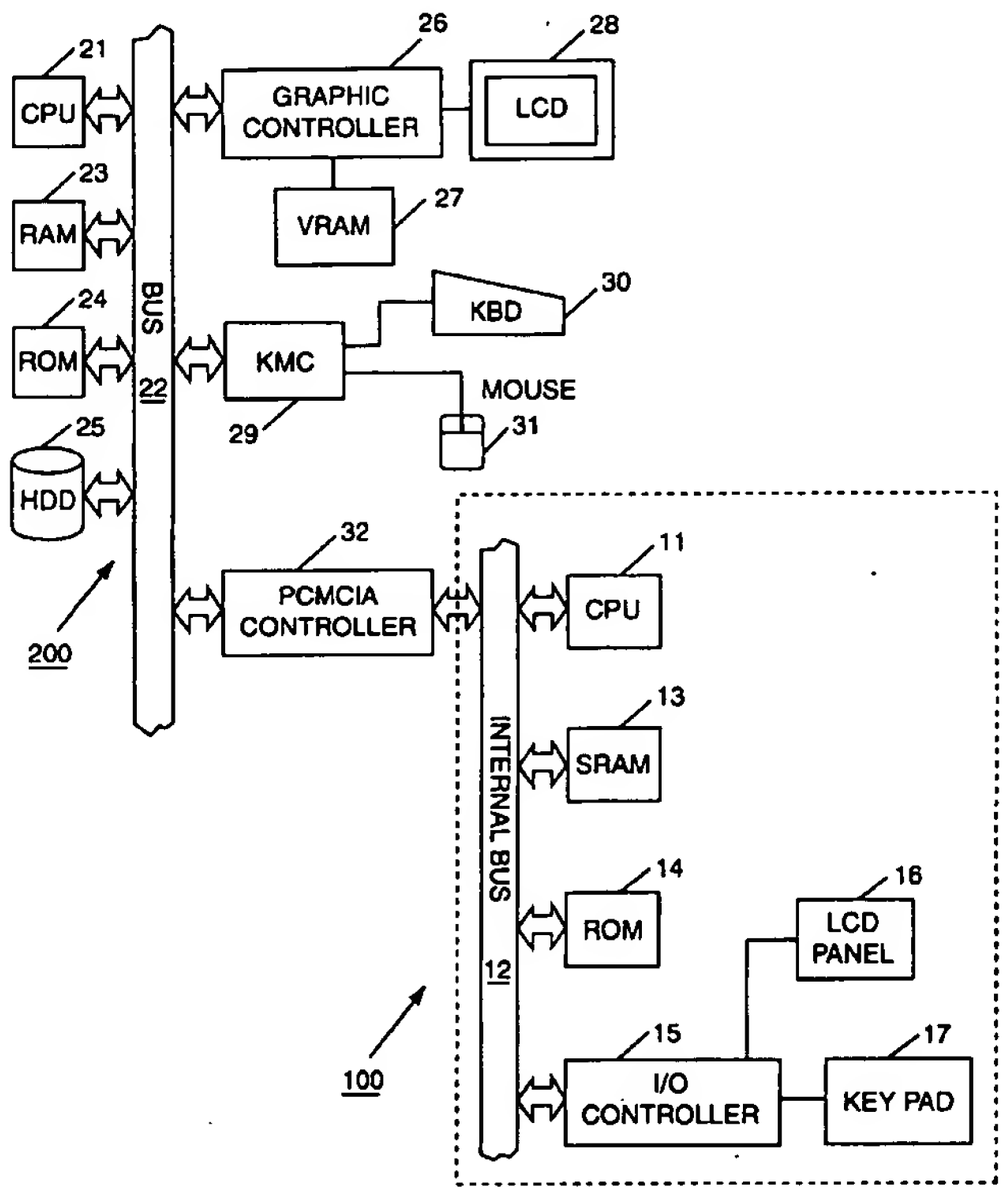
| | | | |
|---|---|---|---|
| 0317481 | 5/1989 | European Pat. Off. | G06F 15/16 |
| 9306553 | 4/1993 | WIPO | G06F 13/28 |
| 9412938 | 6/1994 | WIPO | G06F 15/02 |

*Primary Examiner*—Dung C. Dinh
*Assistant Examiner*—Q.-K. Le
*Attorney, Agent, or Firm*—Anthony N. Magistrale; Daniel E. McConnell

[57] **ABSTRACT**

A data transmission method for transmitting data from a first processing unit having a relatively large memory capacity to a second processing unit having a relatively small memory capacity. The method has steps of (a) retrieving data stored in a first memory device, (b) storing in a temporary file only a record, from the retrieved data, relating to a predetermined time period including a current date; (c) determining whether or not the size of the temporary file is within the capacity of a second, smaller capacity, memory device; and (d) transferring the temporary file to the second processing unit in response to an affirmative result of the step (c), or not transferring the temporary file to the second processing unit in response to a negative result of the step (c).

**2 Claims, 10 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 20 of 23 File: USPT Jul 21, 1998

DOCUMENT-IDENTIFIER: US 5784184 A
TITLE: WDM Optical communication systems with remodulators and remodulating channel selectors

Detailed Description Text (20):
The selected optical channel is converted by electro-optical converter 108, typically a photodiode, to an electrical signal. The electrical signal is amplified by transimpedance amplifier 110 and routed through clock and data recovery circuit 112 for retiming. In an exemplary embodiment, the electrical bandwidth of the optical-to-electrical converter and the transimpedance amplifier is selected to match the data rate of the incoming signal. Optionally, the remodulating channel selector includes forward error correction decoder 114 for accurate reconstruction of the transmitted signal, as discussed above.

Current US Cross Reference Classification (3):
714/713

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US005784184A

# United States Patent [19]

Alexander et al.

[11] Patent Number: 5,784,184

[45] Date of Patent: Jul. 21, 1998

[54] **WDM OPTICAL COMMUNICATION SYSTEMS WITH REMODULATORS AND REMODULATING CHANNEL SELECTORS**

[75] Inventors: **Stephen B. Alexander**, Millersville; **Steve W. Chaddick**, Annapolis; **Roy Litz**, Freeland; **Cecil D. Smith**, Severna Park, all of Md.

[73] Assignee: **CIENA Corporation**, Linthicum, Md.

[21] Appl. No.: **668,746**

[22] Filed: **Jun. 24, 1996**

**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 624,269, Mar. 29, 1996, which is a continuation-in-part of Ser. No. 438,844, May 11, 1995, Pat. No. 5,504,609.

[51] **Int. Cl.**[6] ..... **H04J 14/02**

[52] **U.S. Cl.** ..... **359/125**; 359/130; 359/133; 359/179; 371/20.2

[58] **Field of Search** ..... 359/124–125, 359/130, 133, 174, 176, 179; 371/20.2

[56] **References Cited**

U.S. PATENT DOCUMENTS

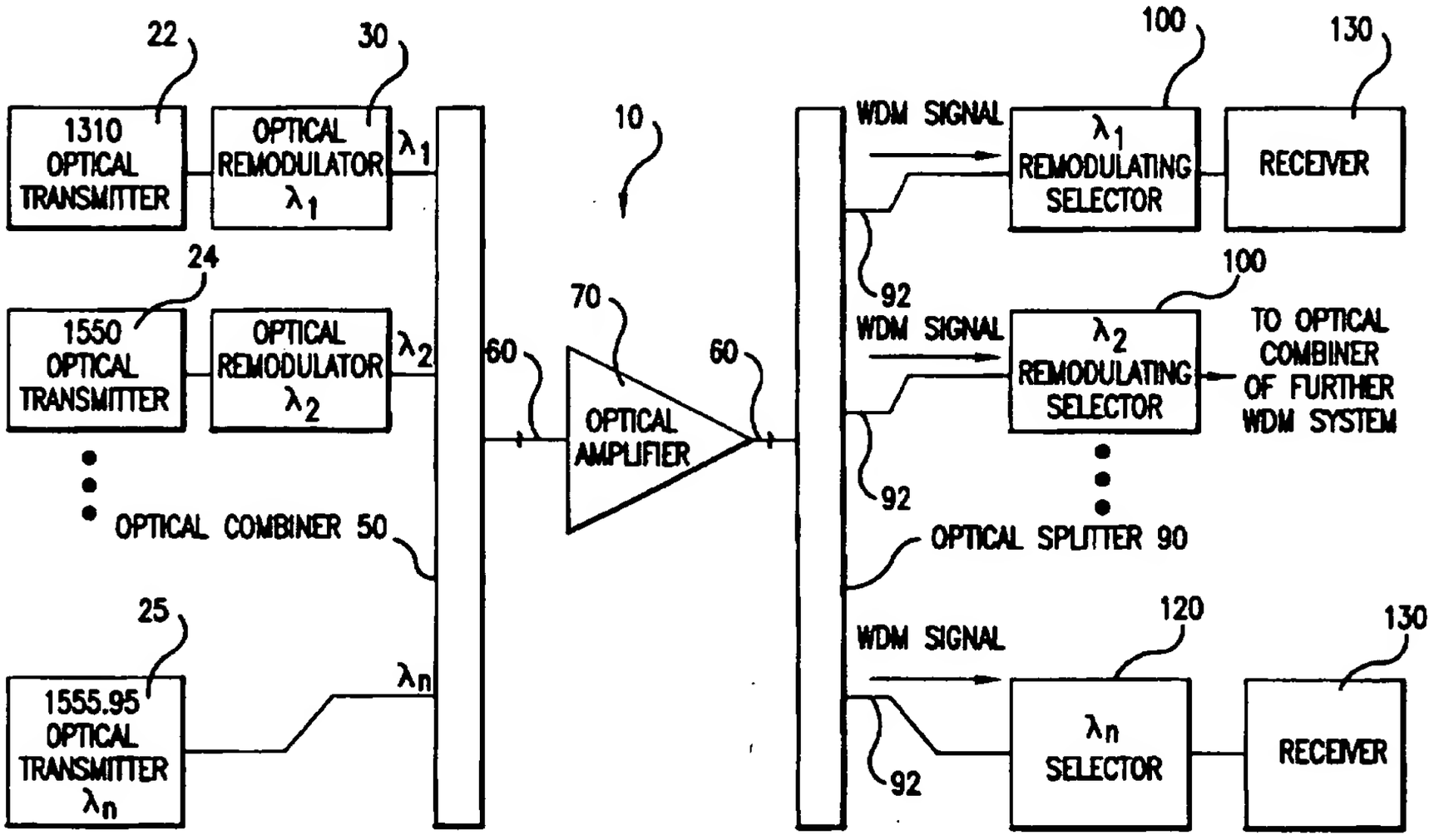
| | | | |
|---|---|---|---|
| 5,351,147 | 9/1994 | Frenkel | 359/124 |
| 5,483,372 | 1/1996 | Green, Jr. | 359/179 |
| 5,504,609 | 4/1996 | Alexander et al. | 359/125 |
| 5,589,969 | 12/1996 | Taza et al. | 359/124 |

*Primary Examiner*—Kinfe-Michael Negash
*Attorney, Agent, or Firm*—Margaret Burke

[57] **ABSTRACT**

The present invention provides a WDM optical communication system with remodulators at the transmission input and remodulating channel selectors adjacent the optical receivers, providing complete control over the interfaces with optical transmission equipment. In an exemplary embodiment, the WDM system includes optical transmitters which input transmitted optical signals into optical remodulators. The optical remodulators place the information from each of the transmitted signals onto separate optical channels in the WDM system channel plan. The optical channels are multiplexed onto an optical waveguide. At the receive end, remodulating channel selectors each receive a portion of the WDM optical signal, select a particular optical channel, and place the information from the selected channel onto a newly-generated optical signal. This newly-generated optical signal is output to a receiver or to a further WDM optical system.

**6 Claims, 3 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L9: Entry 21 of 23 File: USPT Sep 23, 1997

DOCUMENT-IDENTIFIER: US 5671226 A
TITLE: Multimedia information processing system

Detailed Description Text (95):
According to such a structure, the packet sequence output from a plurality of transmission lines can be outputted to other transmission line, as a new there is not a transmission signal 14F, which is inputted from a transmission line, or when the transmission capacity is less than the input, the packet re-multiplexing section 270 selects the element packet 12 and execute speed matching so as to match the transmission capacity of the transmission line on the output side, and controls the transmission signal 14G so as to output to a transmission line.

Current US Cross Reference Classification (3):
709/236

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US005671226A

# United States Patent [19]

Murakami et al.

[11] Patent Number: 5,671,226

[45] Date of Patent: Sep. 23, 1997

[54] **MULTIMEDIA INFORMATION PROCESSING SYSTEM**

[75] Inventors: **Tokumichi Murakami; Kazuhiro Matsuzaki; Yoshiaki Kato; Hideo Ohira**, all of Kanagawa, Japan

[73] Assignee: **Mitsubishi Denki Kabushiki Kaisha**, Tokyo, Japan

[21] Appl. No.: **462,519**

[22] Filed: **Jun. 5, 1995**

[30] **Foreign Application Priority Data**

Feb. 9, 1995 [JP] Japan ..... 7-021699

[51] **Int. Cl.**[6] ..... **H04L 12/56**

[52] **U.S. Cl.** ..... **370/474**; 370/537; 348/423; 395/514 A

[58] **Field of Search** ..... 370/60, 60.1, 94.1, 370/94.2, 99, 389, 474, 537–541; 348/423, 429; 395/514 A

[56] **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 5,461,619 | 10/1995 | Citta et al. | 370/83 |
| 5,521,979 | 5/1996 | Deiss | 380/20 |

OTHER PUBLICATIONS

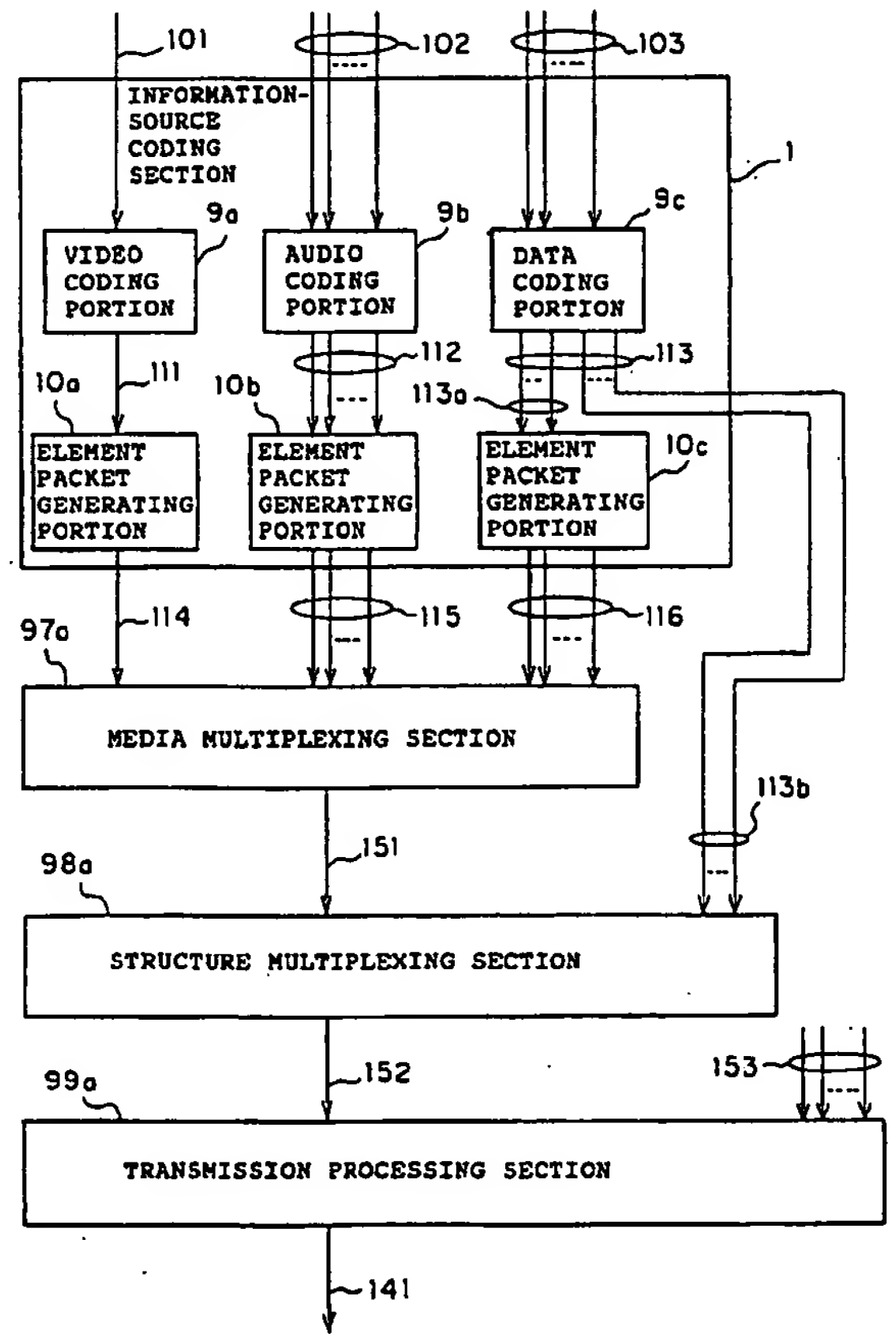
ronald K. Jurgen, Contributing Editor, Mar. 1992, pp. 24–30, IEEE Spectrum, "Digital Video".

*Primary Examiner*—Melvin Marcelo
*Attorney, Agent, or Firm*—Wolf, Greenfield & Sacks, P.C.

[57] **ABSTRACT**

A multimedia information processing system comprises an information-source coding section for generating an element packet containing coded multimedia information and additional information to specify the packet, a packet multiplexing section for generating multiplexed stream by multiplexing the element packet, and a transmission processing section for outputting the multiplexed stream as a transmission signal corresponding transmission media. In this multimedia information processing system, a processing sequence from selection of multimedia information to transmission or storage processing is classified, and the processing contents and input/output data are determined for each hierarchy. Data exchange between services such as broadcasting, communication, storage in computer and so on can be easily attained. Additionally, hardware structure of this system can be simplified, and additional functions can be easily added.

**23 Claims, 19 Drawing Sheets**



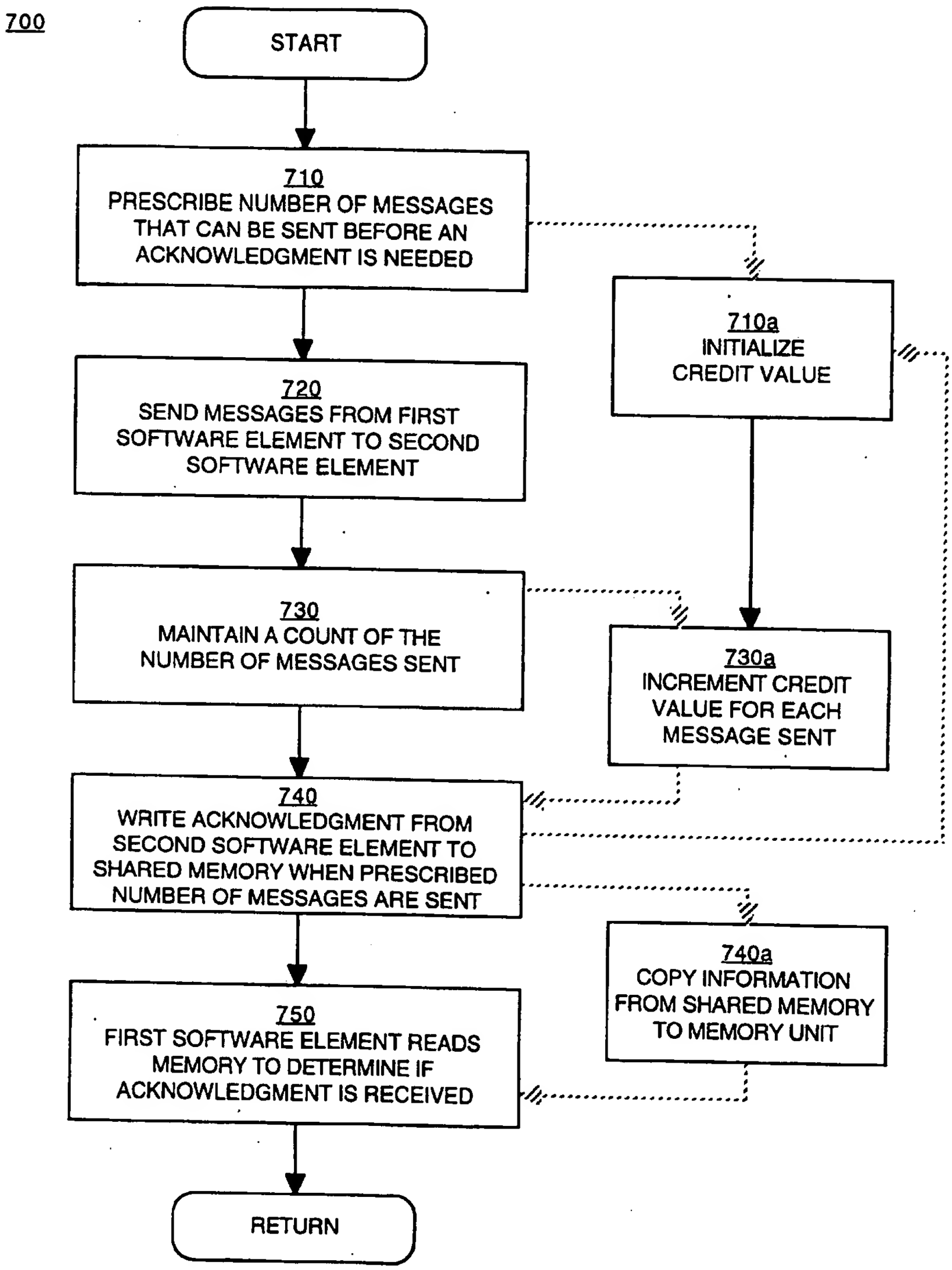

700
START
710
PRESCRIBE NUMBER OF MESSAGES THAT CAN BE SENT BEFORE AN ACKNOWLEDGMENT IS NEEDED
710a
INITIALIZE CREDIT VALUE
720
SEND MESSAGES FROM FIRST SOFTWARE ELEMENT TO SECOND SOFTWARE ELEMENT
730
MAINTAIN A COUNT OF THE NUMBER OF MESSAGES SENT
730a
INCREMENT CREDIT VALUE FOR EACH MESSAGE SENT
740
WRITE ACKNOWLEDGMENT FROM SECOND SOFTWARE ELEMENT TO SHARED MEMORY WHEN PRESCRIBED NUMBER OF MESSAGES ARE SENT
740a
COPY INFORMATION FROM SHARED MEMORY TO MEMORY UNIT
750
FIRST SOFTWARE ELEMENT READS MEMORY TO DETERMINE IF ACKNOWLEDGMENT IS RECEIVED
RETURN

Figure 7

Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L2: Entry 5 of 45 File: USPT Jul 20, 2004

DOCUMENT-IDENTIFIER: US 6766358 B1
TITLE: Exchanging messages between computer systems communicatively coupled in a computer system network

Detailed Description Text (40):
In step 740, when the number of messages sent is equal to the prescribed number from step 710, no further messages associated with the particular transaction of interest are sent from the source software element until an acknowledgment is received from the target software element. In accordance with the present invention, the acknowledgment is written to shared memory (e.g., shared memory 354 and 315 of FIGS. 5A and 5B, respectively). In one embodiment, the acknowledgment is written to shared memory using a DMA operation.

Current US Original Classification (1):
709/213

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006766358B1

(12) **United States Patent**
**Chesson et al.**

(10) **Patent No.: US 6,766,358 B1**
(45) **Date of Patent: Jul. 20, 2004**

(54) **EXCHANGING MESSAGES BETWEEN COMPUTER SYSTEMS COMMUNICATIVELY COUPLED IN A COMPUTER SYSTEM NETWORK**

(75) Inventors: **Gregory L. Chesson**, Palo Alto, CA (US); **James T. Pinkerton**, Sunnyvale, CA (US); **Eric Salo**, Apple Valley, MN (US)

(73) Assignee: **Silicon Graphics, Inc.**, Mountain View, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/427,203**

(22) Filed: **Oct. 25, 1999**

(51) **Int. Cl.**[7] ..... **G06F 13/00**
(52) **U.S. Cl.** ..... **709/213**
(58) **Field of Search** ..... 709/200, 201, 709/202, 203, 216, 212, 206, 207, 213, 214, 215, 310, 312, 313, 217, 234; 710/56; 711/173, 107, 202; 714/100, 699, 746, 748, 749

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 5,239,643 | A | 8/1993 | Blount et al. | 395/425 |
| 5,404,478 | A | 4/1995 | Arai et al. | 395/400 |
| 5,522,045 | A | 5/1996 | Sandberg | 395/200.08 |
| 5,606,666 | A * | 2/1997 | Grant et al. | 709/216 |
| 5,961,606 | A * | 10/1999 | Talluri et al. | 709/234 |
| 6,430,598 | B1 * | 8/2002 | Dorrance et al. | 714/748 |

OTHER PUBLICATIONS

Katevenis M: "Telegraphos: High–Speed Communication Architecture for Parallel and Distributed Computer Systems" Technical Report Forth–ICS, XX,XX, No. TR 123, May 1, 1994 (1994–05–01), pp. 1–39, XP002038871, p. 3, line 9–line 27; figures 2.1, 3.2; p. 20, line 1–p. 21, last line; p. 26, line 35–p. 27, line 31.

Gillett R.B.: "Memory Channel Network for PCI" IEEE Micro, US, IEEE Inc., New York, vol. 16, No. 1, Feb. 1, 1996 (1996–02–01), pp. 12–18, XP00055223 ISSN: 0272–1732, p. 14, right–hand column, line 38–p. 16, right–hand column, line 35; figures 2, 4.

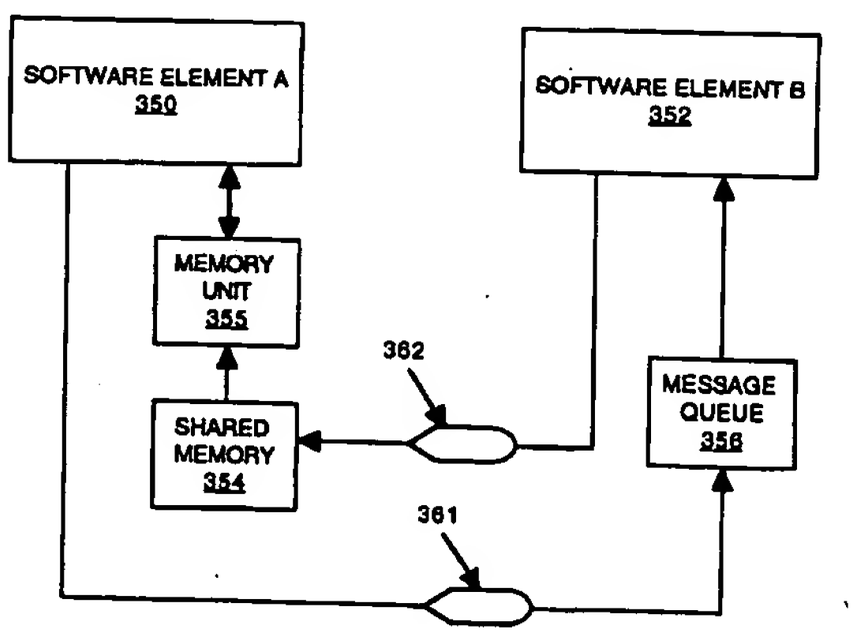
* cited by examiner

*Primary Examiner*—Robert B. Harrell
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A method for exchanging messages between computer systems communicatively coupled in a computer system network. A message (e.g., a read or write command) is sent from a software element of a first computer system (e.g., a client computer system) to a second computer system (e.g., a server computer system). A shared memory unit is accessible by the software element of the first computer system and a software element of the second computer system. The shared memory unit of the second computer system is directly accessed, bypassing the processor of the second computer system, and the data of interest is read or written from/to the shared memory unit. In one embodiment, the method pertains to acknowledgments between software elements. A plurality of messages is sent from one software element to another software element. A count of each of the plurality of messages is maintained. An acknowledgment message acknowledging receipt of a prescribed number of the messages is written to a shared memory unit when the count reaches the prescribed number.

**22 Claims, 8 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L2: Entry 15 of 45 File: USPT May 6, 2003

DOCUMENT-IDENTIFIER: US 6560630 B1
TITLE: Receive load balancing and fail over with multiple network interface cards

Brief Summary Text (8):
For example, in a TCP/IP (Transmission Control Protocol/Internet Protocol) transaction initiated by a server computer system, data packets are transmitted from the server computer system to a client computer system. After a certain number of data packets are transmitted and received, an acknowledgment signal is sent from the client computer system and received by the server system; the number of data packets that can be transmitted between acknowledgments is often referred to as the window size.

Current US Cross Reference Classification (1):
709/250

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006560630B1

(12) **United States Patent**
**Vepa et al.**

(10) **Patent No.: US 6,560,630 B1**
(45) **Date of Patent: May 6, 2003**

(54) **RECEIVE LOAD BALANCING AND FAIL OVER WITH MULTIPLE NETWORK INTERFACE CARDS**

(75) Inventors: **RamKrishna Vepa**, Danville, CA (US); **Roman G. Baker**, San Jose, CA (US); **Sameer Nanda**, Sunnyvale, CA (US); **Thomas A. Maufer**, Santa Clara, CA (US)

(73) Assignee: **3Com Corporation**, Santa Clara, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/272,695**

(22) Filed: **Mar. 18, 1999**

(51) **Int. Cl.**[7] ..... **G06F 9/00**
(52) **U.S. Cl.** ..... **709/105**; 709/250
(58) **Field of Search** ..... 709/105, 250, 709/220, 223–224, 235, 238

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 5,774,660 A * | 6/1998 | Brendel et al. | ..... | 709/105 |
| 5,918,021 A * | 6/1999 | Aditya | ..... | 709/235 |
| 6,208,616 B1 * | 3/2001 | Mahalingam et al. | ..... | 370/216 |
| 6,243,360 B1 * | 6/2001 | Basilico | ..... | 709/250 |
| 6,253,334 B1 * | 6/2001 | Amdahl et al. | ..... | 709/105 |
| 6,381,218 B1 * | 4/2002 | McIntyre et al. | ..... | 370/245 |
| 6,393,483 B1 * | 5/2002 | Latif et al. | ..... | 709/226 |
| 6,424,621 B1 * | 7/2002 | Ramaswamy et al. | ..... | 709/105 |

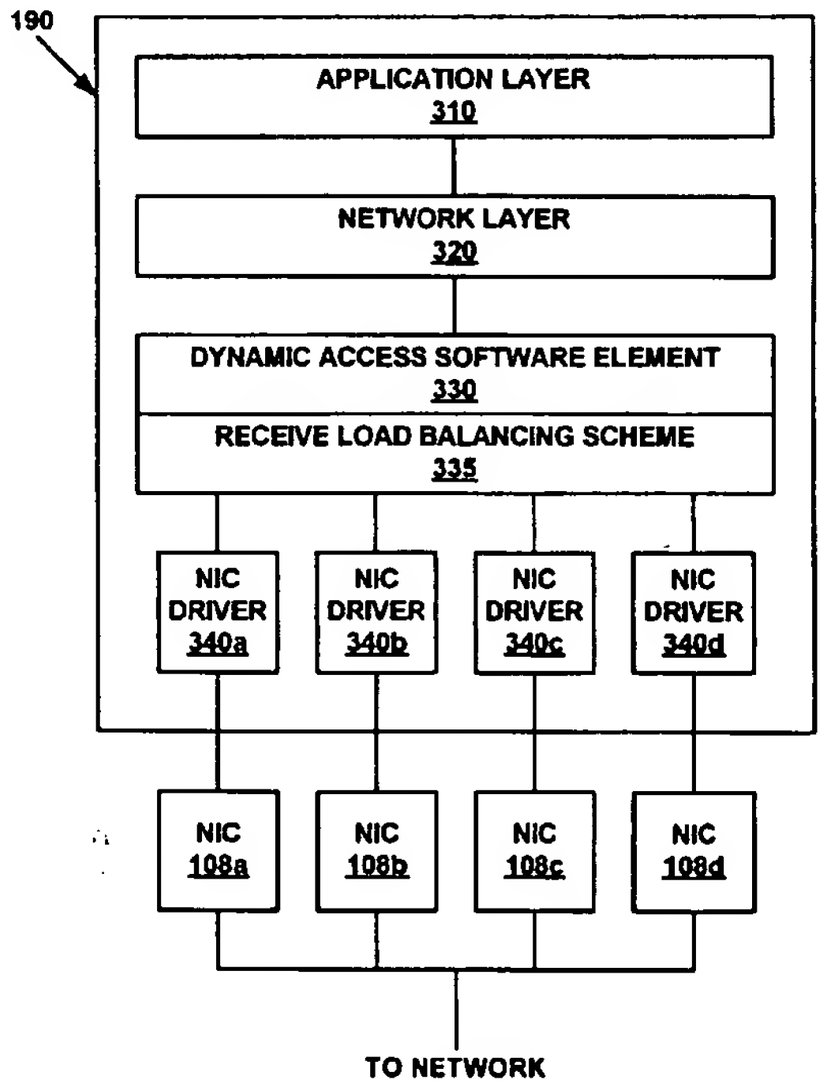
* cited by examiner

*Primary Examiner*—Ayaz Sheikh
*Assistant Examiner*—Philip B. Tran
(74) *Attorney, Agent, or Firm*—Wagner, Murabito & Hao LLP

(57) **ABSTRACT**

A method for load balancing incoming data packets in a server computer system adapted to have a plurality of network interface cards coupled thereto and communicatively coupled to client computer systems in a network. A first media access control (MAC) address for a first NIC is selected using a load balancing scheme. A first directed data packet containing the first MAC address and a network address for the server computer system is sent to a first client computer system. The first MAC address and the network address are stored in a protocol cache of the first client computer system. A second MAC address for a second NIC is also selected using the load balancing scheme. A second directed packet containing the second MAC address and the network address is sent to a second client computer system. The second MAC address and the network address are stored in a protocol cache of the second client computer system. Thus, the server computer system will receive an incoming data packet from the first client computer system over the first NIC and from the second computer system over the second NIC.

**23 Claims, 14 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L2: Entry 16 of 45 File: USPT Apr 22, 2003

DOCUMENT-IDENTIFIER: US 6553032 B1
TITLE: Packeting timeout spoofing in a wireless data communications network

Brief Summary Text (14):
That is, in a stream of data comprising packet numbers 1-15, where a window consists of ten packets, if packets 1-5 and 7-15 have been received successfully, each acknowledgment sent for a packet received after packets 1-5 have been received, specifies that packet 6, the next highest contiguous packet, is expected. Once three acknowledgments requesting packet 6 have been sent, the RFC 2001 performance enhancing algorithm is invoked and packets 6-15 are resent by the sending unit even though packets 7-15 have been successfully received by the receiving unit.

Detailed Description Text (4):
Once the connections are established, a user at the PC 12 and the NSU 16 may share data. In accordance with the TCP/IP protocol, a receiving unit sends an acknowledgment message to a sending unit upon receipt of a sent packet of data. In addition, where a sliding window protocol is followed, a limit is placed on a maximum number of outstanding packets allowed in the system. In accordance with the sliding window protocol, once the maximum number of outstanding, unacknowledged packets have been sent, the sending unit stops sending packets until an acknowledgment is received. The receiving unit may provide cumulative acknowledgment messages which indicate a number of consecutive packets which have been received.

Current US Cross Reference Classification (5):
714/748

Current US Cross Reference Classification (6):
714/749

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006553032B1

(12) **United States Patent**
**Farley et al.**

(10) **Patent No.: US 6,553,032 B1**
(45) **Date of Patent: Apr. 22, 2003**

(54) **PACKETING TIMEOUT SPOOFING IN A WIRELESS DATA COMMUNICATIONS NETWORK**

(75) Inventors: **Kevin L. Farley**, Palm Bay, FL (US); **Brian L. Kilgore**, Melbourne, FL (US)

(73) Assignee: **Tantivy Communications, Inc.**, Melbourne, FL (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/388,000**

(22) Filed: **Sep. 1, 1999**

(51) **Int. Cl.**[7] ..... **H04L 12/56**
(52) **U.S. Cl.** ..... **370/394**; 370/428; 370/349; 370/236; 370/229; 714/748; 714/749
(58) **Field of Search** ..... 370/394, 428, 370/236, 236.1, 349; 714/748, 749

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 4,675,863 | A | 6/1987 | Paneth et al. | 370/50 |
| 4,817,089 | A | 3/1989 | Paneth et al. | 370/95 |
| 4,912,705 | A | 3/1990 | Paneth et al. | 370/95.1 |
| 5,325,419 | A | 6/1994 | Connolly et al. | 379/60 |
| 5,412,429 | A | 5/1995 | Glover | 348/398 |
| 5,585,850 | A | 12/1996 | Schwaller | 348/388 |
| 5,617,423 | A | 4/1997 | Li et al. | 370/426 |
| 5,655,001 | A | 8/1997 | Cline et al. | 370/328 |
| 5,657,358 | A | 8/1997 | Paneth et al. | 375/356 |
| 5,687,194 | A | 11/1997 | Paneth et al. | 375/283 |
| 5,697,059 | A | 12/1997 | Carney | 455/34.1 |
| 5,974,028 | A * | 10/1999 | Ramakrishnan | 370/229 |
| 6,298,041 | B1 * | 10/2001 | Packer | 370/231 |

FOREIGN PATENT DOCUMENTS

| | | |
|---|---|---|
| EP | 0 526 106 A2 | 2/1993 |
| EP | 0 682 423 A2 | 11/1995 |
| EP | 0 719 062 A2 | 6/1996 |
| WO | WO 96/08934 | 3/1996 |
| WO | WO 96/37081 | 11/1996 |
| WO | WO 98/37670 | 8/1998 |

OTHER PUBLICATIONS

Melanchuk, et al., "CDPD and Emerging Digital Cellular Systems," *Digest of Papers of Compcon*, Computer Society Conference 1996, Technologies for the Information Superhighway, Santa Clara, CA., no. Conf. 41, pp. 2–8 (Feb. 25, 1996), XP000628458 Institute of Electrical and Electronics Engineers.

Jorge A. Cobb, et. al., "*Congestion of Corruption? A Strategy for Efficient Wireless TCP Sessions*," Proceedings IEEE Symposium on Computers and Communications pp. 262–268 XP000568953 (1995).

Elan Amir, et. al., "*Efficient TCP over Networks with Wireless Links*," Fifth Workshop on Hot Topics in Operating Systems pp. 35–40 XP002150718 (May 4–5, 1995).

Hari Balakrishnan, et. al, "*Improving Reliable Transport and Handoff Performance in Cellular Wireless Networks*," ACM Mobile Computing and Network Conference pp. 1–19, XP002150717 (Nov. 14–15, 1995).

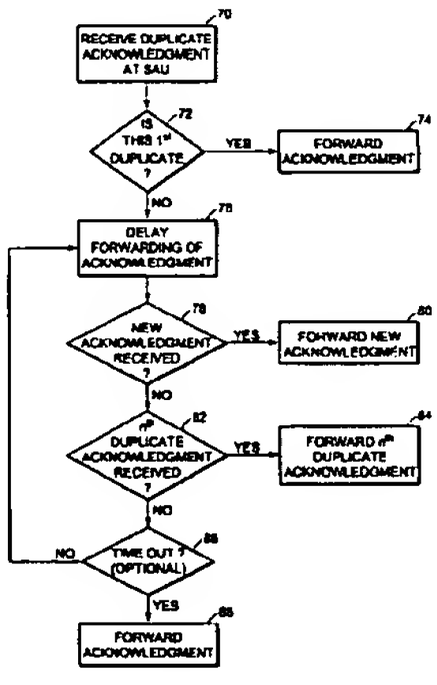
* cited by examiner

*Primary Examiner*—Daniel Hunter
*Assistant Examiner*—Alan T. Gantt
(74) *Attorney, Agent, or Firm*—Hamilton, Brook, Smith & Reynolds, P.C.

(57) **ABSTRACT**

Method and apparatus are provided to prevent unneccessary execution of TCP/IP performance enhancing algorithms in a wireless communications network. The method includes monitoring acknowledgment message traffic between a sending unit and a receiving unit and preventing forwarding of an acknowledgment message to the sending unit when the acknowledgment message is a second duplicate acknowledgment message. The apparatus includes a first endpoint unit connected between a sending unit and a receiving unit. The first endpoint unit includes a monitor component to monitor acknowledgment message traffic between the sending unit and the receiving unit and a filter unit to prevent forwarding of a duplicate acknowledgment message to the sending unit until a predefined condition is met.

**14 Claims, 6 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L2: Entry 18 of 45 File: USPT Nov 12, 2002

DOCUMENT-IDENTIFIER: US 6480897 B1
TITLE: Optimistic transmission flow control including receiver data discards upon inadequate buffering condition

Brief Summary Text (22):
To control this operation at both the source and destination nodes, the source node maintains a message sent number, as well as an expected acknowledgment number, which is incremented as respective acknowledgments of successfully accommodated data portions of messages are received from the destination node. The destination node maintains a respective message number which is incremented as respective initial transmissions or retransmissions of data portions are successfully accommodated, as well as an expected "runt" number which is incremented as respective data portions of messages are discarded and negative acknowledgments transmitted to the source node therefor.

Current US Original Classification (1):
709/237

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006480897B1

(12) **United States Patent**
**Desnoyers et al.**

(10) **Patent No.: US 6,480,897 B1**
(45) **Date of Patent: *Nov. 12, 2002**

(54) **OPTIMISTIC TRANSMISSION FLOW CONTROL INCLUDING RECEIVER DATA DISCARDS UPON INADEQUATE BUFFERING CONDITION**

(75) Inventors: **Christine M. Desnoyers**, Pine Bush, NY (US); **Douglas J. Joseph**, New Fairfield, CT (US); **Francis A. Kampf**, Fairfax, VT (US); **Alan F. Benner**, Poughkeepsie, NY (US)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

( * ) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **08/998,965**

(22) Filed: **Dec. 29, 1997**

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 08/856,619, filed on May 13, 1997, now Pat. No. 5,931,915.

(51) **Int. Cl.**[7] ..... **G06F 15/16**
(52) **U.S. Cl.** ..... **709/237**; 710/100
(58) **Field of Search** ..... 370/79, 85.13, 370/230, 94.1, 276, 216, 229.95, 237, 395, 229; 395/180, 182.16, 706; 709/233, 237, 200, 236, 245, 231, 232, 216, 105, 222, 235; 371/32; 380/45, 42; 710/100; 340/825.44; 375/219

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,906,445 A * 9/1975 Beckmann et al. ..... 340/146.1
4,630,259 A * 12/1986 Larson et al. ..... 370/216
4,672,543 A * 6/1987 Matsui et al. ..... 709/235
4,745,599 A 5/1988 Raychaudhuri ..... 370/348
4,799,215 A 1/1989 Suzuki ..... 370/227

(List continued on next page.)

OTHER PUBLICATIONS

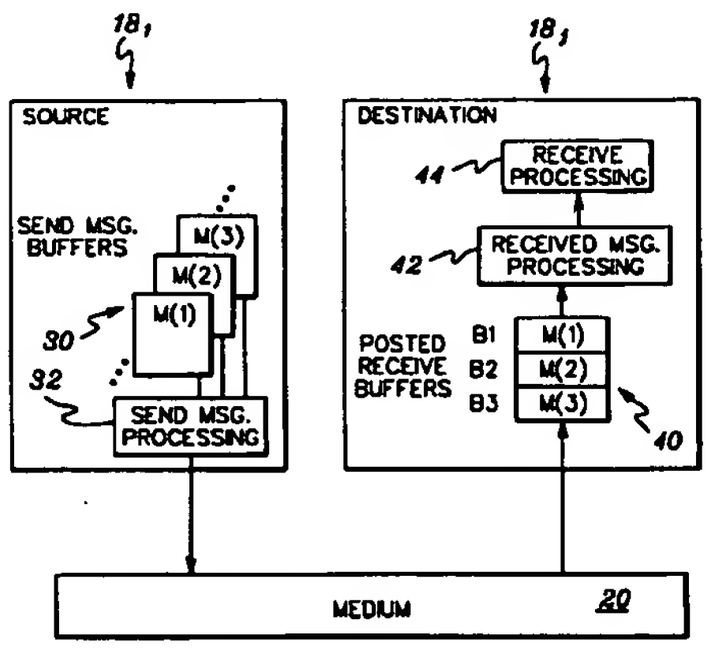
Danzig, Flow Control for Limited Buffer Multicast, IEEE 1994.*

*Primary Examiner*—Mark H. Rinehart
*Assistant Examiner*—Thong Vu
(74) *Attorney, Agent, or Firm*—Floyd A. Gonzalez, Esq.; Lawrence D. Cutter, Esq.; Heslin Rothenberg Farley & Mesiti P.C.

(57) **ABSTRACT**

A program product for a message processing system in which messages are transmitted from source nodes to destination nodes. A transmission flow control technique is disclosed in which the source node optimistically sends control information and a data portion of a message, and wherein a destination node discards the data portion of the message if it is unable to accommodate it. The destination node, however, retains enough of the control information to identify the message to the source node, and when the destination node is subsequently able to accommodate the data portion, the destination node issues a request to the source node to retransmit the data portion of the message. Discarding of one message is followed by discards of sequential messages, until the destination node is able to accommodate the data portions of messages. The flow control technique disclosed herein is used, for example, in an environment where buffers are posted to accommodate messages at the destination node, and is particularly suited for conditions arising in multi-tasking systems where the destination node is generally assumed to be prepared to accommodate data, however, if not prepared, is likely not prepared for long periods of time.

**19 Claims, 2 Drawing Sheets**



Previous Doc Next Doc Go to Doc#
First Hit Fwd Refs

Generate Collection

L2: Entry 29 of 45 File: USPT Apr 17, 2001

DOCUMENT-IDENTIFIER: US 6219713 B1
TITLE: Method and apparatus for adjustment of TCP sliding window with information about network conditions

Abstract Text (1):
A method and apparatus for adjustment of TCP sliding window with information about network conditions is disclosed. The present invention obtains information from the network below TCP about the condition of the network and traffic and uses this information to control the transmission of the TCP source without any modifications to the existing TCP sources. The invention includes the steps of receiving feedback information in an acknowledgment packet, receiving a packet having an advertised window field set to an original advertised window size for a sliding window, and modifying the advertised window field to chose the size of the sliding window in response to feedback information received in the acknowledgment packet. The original advertised window size indicates the original size of a sliding window for determining a number of bytes that can be sent before an acknowledgment packet is received. The feedback information further includes a window advertisement. The size of the sliding window includes the minimum of the window advertisement and a congestion window. The window advertisement specifies an increase to the size of the sliding window. The increase includes an additional number of octets of data a receiver is prepared to accept. The method further includes the steps of calculating a modified advertised window size using the window advertisement, comparing the modified advertised window size to an original advertised window size and transmitting an acknowledgment including the least of the modified advertised window size and the original advertised window size.

Brief Summary Text (21):
Other embodiments of a system in accordance with the principles of the invention may include alternative or optional additional aspects. One such aspect of the present invention is that the original advertised window size indicates the original size of a sliding window for determining a number of bytes that can be sent before an acknowledgment packet is received.

Current US Original Classification (1):
709/235

CLAIMS:

1. A TCP source in a network comprising a sliding window, the sliding window having a size for determining a number of bytes that can be sent before an acknowledgment packet is received by the TCP source, wherein the size of the sliding window is chosen in response to information received from a TCP receiver in an acknowledgment packet indicating a load condition and traffic congestion for the network.

8. A feedback information converter, comprising a processor for receiving information from a TCP receiver in an acknowledgment packet indicating a load condition and traffic congestion for the network and a packet having an advertised window field set to an original advertised window size, the original advertised window size indicating the original size of a sliding window for determining a

h e b b g e e e f e hf e e g

number of bytes that can be sent before an acknowledgment packet is received, the processor modifying the advertised window field to change the size of the sliding window in response to feedback information received in the acknowledgment packet.

20. The method of claim 15 wherein the original advertised window size indicates the original size of a sliding window for determining a number of bytes that can be sent before an acknowledgment packet is received.

22. An access node providing a gateway to a network for a source, the access node comprising a feedback information converter, the feedback information converter further comprising a processor for receiving information from a TCP receiver in an acknowledgment packet indicating a load condition and traffic congestion for the network and a packet having an advertised window field set to an original advertised window size, the original advertised window size indicating the original size of a sliding window in a previous node for determining a number of bytes that can be sent before an acknowledgment packet is received, the processor modifying the advertised window field to change the size of the sliding window in response to feedback information received in the acknowledgment packet.

26. A TCP receiver comprising a feedback information converter, the feedback information converter further comprising a processor for receiving information from a subsequent TCP receiver in an acknowledgment packet indicating a load condition and traffic congestion for the network and a packet having an advertised window field set to an original advertised window size, the original advertised window size indicating the original size of a sliding window in a previous node for determining a number of bytes that can be sent before an acknowledgment packet is received, the processor modifying the advertised window field to change the size of the sliding window in response to feedback information received in the acknowledgment packet.

Previous Doc Next Doc Go to Doc#

h e b b g e e e f e hf e e g

US006219713B1

(12) **United States Patent**
**Ruutu et al.**

(10) **Patent No.: US 6,219,713 B1**
(45) **Date of Patent: Apr. 17, 2001**

(54) **METHOD AND APPARATUS FOR ADJUSTMENT OF TCP SLIDING WINDOW WITH INFORMATION ABOUT NETWORK CONDITIONS**

(75) Inventors: **Jussi Ruutu; Kalevi Kilkki**, both of Espoo (FI)

(73) Assignee: **Nokia Telecommunications, Oy**, Espoo (FI)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/111,205**

(22) Filed: **Jul. 7, 1998**

(51) **Int. Cl.**[7] ..... **G06F 13/00**

(52) **U.S. Cl.** ..... **709/235**

(58) **Field of Search** ..... 370/231, 232, 370/233, 234, 238, 342, 412, 397, 230; 379/6; 709/235, 200, 218, 228, 232, 230; 710/60

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| 5,042,029 | 8/1991 | Hayakawa | 370/231 |
| 5,410,585 | 4/1995 | Kawaharata | 379/6 |
| 5,546,389 | 8/1996 | Wippenbeck et al. | 370/412 |
| 5,592,627 | 1/1997 | Burt et al. | 709/232 |
| 5,708,660 | 1/1998 | Riedel | 370/397 |
| 5,748,615 | 5/1998 | Riedel et al. | 370/238 |
| 5,768,627 | 6/1998 | Jones et al. | 710/60 |
| 5,805,577 | 9/1998 | Jain et al. | 370/234 |
| 5,805,585 | 9/1998 | Javitt et al. | 370/342 |
| 5,812,527 | 9/1998 | Kline et al. | 370/232 |
| 6,041,039 * | 3/2000 | Kilkiki et al. | 370/230 |

FOREIGN PATENT DOCUMENTS

| | | |
|---|---|---|
| 2 203 617 | 10/1988 | (GB) . |
| WO 97/36410 | 10/1997 | (WO) . |

OTHER PUBLICATIONS

"ATM Lecture", Internet http://syllabus.syr.edu/lst/Mweschen/lst656/Week4/lecture/atm/atm.htm, pp. 1–5 (Feb. 6, 1997).

"Integrated Services Digital Network (ISDN) Overall Network Aspects and Functions, Traffic Control and Congestion Control in B–ISDN", International Telecommunication Union, ITU–T Recommendation I.371, pp. 1–27 (Mar. 1993).

(List continued on next page.)

*Primary Examiner*—Robert B. Harrell
(74) *Attorney, Agent, or Firm*—Altera Law Group, LLC

(57) **ABSTRACT**

A method and apparatus for adjustment of TCP sliding window with information about network conditions is disclosed. The present invention obtains information from the network below TCP about the condition of the network and traffic and uses this information to control the transmission of the TCP source without any modifications to the existing TCP sources. The invention includes the steps of receiving feedback information in an acknowledgment packet, receiving a packet having an advertised window field set to an original advertised window size for a sliding window, and modifying the advertised window field to chose the size of the sliding window in response to feedback information received in the acknowledgment packet. The original advertised window size indicates the original size of a sliding window for determining a number of bytes that can be sent before an acknowledgment packet is received. The feedback information further includes a window advertisement. The size of the sliding window includes the minimum of the window advertisement and a congestion window. The window advertisement specifies an increase to the size of the sliding window. The increase includes an additional number of octets of data a receiver is prepared to accept. The method further includes the steps of calculating a modified advertised window size using the window advertisement, comparing the modified advertised window size to an original advertised window size and transmitting an acknowledgment including the least of the modified advertised window size and the original advertised window size.

**29 Claims, 4 Drawing Sheets**